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## ORDINARY MEETING, 21st February, 1870.

THE REV. DR. ROBINSON THORNTON, VICE-PRESIDENT, IN THE CHAIR.

The Minutes of the last Meeting were read and confirmed.

The Secretary announced that Mr. Herbert James, H.M.C.S., had been elected a member of the Institute.

Professor KIRK then read the following paper :—

### *ON SPONTANEOUS GENERATION; or, THE PROBLEM OF LIFE. By the Rev.* JOHN KIRK, *Professor of Practical Theology in the Evangelical Union Academy, Glasgow; M.V.I.*

THE idea which one forms of that which is called *Life* will be essentially varied according to the surrounding ideas in the midst of which it is formed. If these surrounding ideas represent strictly material objects and their affections, the idea of life will be essentially different from that which is formed when surrounding ideas represent immaterial objects and their affections. Where all substances are excluded from the thoughts but such as can be seen, or in some other way directly perceived through the senses, the idea of life will be one thought; where those substances which exist, and which make their existence perfectly manifest to reason, though they cannot be seen, are fully taken into view, the idea of life will be a very different thought.

2. I make this preliminary remark, because my definition of life must be one thing if I speak of it in strict materialism, and it must be a totally different thing if I speak of it according to the full truth and reason of the case. Life, *as it is seen*, is a movement, and nothing more. It is nothing but a movement to any of the five senses. Every movement is not life, but every instance of life may be resolved into movement only if we go no further than the senses enable us to go in our thoughts of living objects. But there is something about the movement which we call "life" which is accessible to the

eye, and yet brings us to the verge of the seen, if not really into the unseen. Life in an object is *self-movement.* No one thinks of an object as alive merely because it is in motion; it must move itself in order to be *alive* even to the eye, or to any other organ of sense. Whether it is the life of animal or of vegetable, in order to be life at all, it must be motion having its true origin in the living animal or plant. It must not merely be moved—it must move itself. Mechanical movements are not life; magnetic movements and chemical combinations, however forcible, are not life. You may call them by that name, but you cannot think of them in the true thought, even in materialism, which belongs to life itself.

3. It is this self-moving which constrains us to reason about life as we never dream of reasoning about any other form of motion. It is this which compels us logically to look beyond the region of observation to which the material eye and lens are confined, and with another eye which needs no microscope to see, so to speak, that which neither telescope nor microscope can reveal. *Thoughts* cannot be seen by means of the microscope, yet thoughts are surely as real as the movements of vibrios; that which thinks cannot be purified by being passed through potassium, yet it is as real as the air which may be so affected; the substances which think cannot be "resolved" by the telescope, yet they are at least as truly existent as the nebulæ. When fairly in the midst of true thoughts, such as surround the idea of life, we speak of it as a *force* and not as a movement. It is now no longer motion, but that power which moves. The problem of life, then, is not the problem of a movement, but of a faculty. It takes us back beyond the motion which can be seen to the *motive entity* which cannot be seen.

4. To pure materialism, the dormant seed or germ is not alive. It is not in motion, and that which is not in motion in strict materialism is not living. A materialist regards a fresh though dormant seed as alive; but when he does so, he departs from his materialism. He goes beyond "phenomena," for there is no such phenomenon as lets life be seen so long as there is no visible movement in the germ. Place that germ under the microscope while as yet it is not affected by the conditions of growth, and there is nothing to be seen which tells of actual life. The strictest materialist knows that there is life there—that there is something essentially the opposite of that which is where the germ has been deprived of its vitality. That something is life; but he does not know it—he cannot possibly know it—except by reasoning, which informs of that which cannot be seen or in any way subjected

to the senses. It is not at all needful to regret such an inconsistency or to confine ourselves to *seen life*.

5. To generate is to give beginning. Used in such a discussion as that in which we are at present engaged, generation means the giving of a beginning to life or self-movement in an individual plant or animal. Spontaneous generation literally would mean to give such a beginning to oneself, and would of course be absurd. But the phrase is not used literally. The idea which it is intended to represent is that of the lifeless giving origin to the living. The inorganic is thought of as giving origin to the organic, and the vegetable as giving origin to the animal. It is true that as yet the only notion which evolutionists attempt to support is that of previously organic molecules giving origin to individual life, and the vegetable thus generating the animal; but that is of no value to their system of thought apart from the truly inorganic generating the organic, at least in the vegetable. The chain of evolution is incomplete and useless to their purpose until this link is forged and inserted.

6. Darwin speaks of the creation of a few forms, or of one; but if the notion of those who hold to really molecular generation held good, he would have no need for such a thought. Here, for example, is an infusion of hay, and it has been so treated that all truly organic existence in it is held to be destroyed. If it could only now be fairly regarded as inorganic matter,—if living plants, however small, could be seen springing into existence from it, and if these mere plants could be seen uniting themselves and becoming self-moving animals, what a grand commencement would here be made for the Darwinian theory! It wants only sufficient time, and the films that become molecules, these molecules that become vibrios, these vibrios that become higher forms, and these higher forms that become higher still, shall reach the human form at last! The symmetry of the notion is perfect. The mischief-maker in the case is that enemy of all mere notions—stern old Fact. It is no doubt wonderful how this old foe is evaded, and even wheedled into something like acquiescence for a time; but ever and again, like Galileo on the earth's motion, he spoils the sport by assertions that damage the whole structure of fond fancy.

7. Let us try, by means of some suitable illustration, to have a good, clear view of this notion as to the origin of life. Perhaps we cannot get a better than that which is found in the case of a grave Professor who is an enthusiast in this same notion. It is far better to take one who is on the positive side in favour of a fancy, and to take his facts and arguments,

than to take one who is on the negative side and opposed. Well, this gentleman has his students around him and a first-rate microscope on the table. He has before him an infusion of hay as well as infusions of certain other substances, vegetable and animal. Let us attend to that of hay. The dried grass has been steeped for a considerable time in water; the infusion has been boiled pretty thoroughly. It has been carefully excluded from all contact with ordinary atmospheric air, that substance having been admitted to it through such media as must effectually exclude or destroy all germs of plants or animals which it might contain. The infusion has been kept bottled up for some months, to give time to the process of generation. A thin scum now floats on the surface of this infusion. With the point of a needle, the Professor or an assistant lifts the smallest portion of this film and places it under the object-glass of the microscope. This fragment is now seen by some, though not by all who look through the instrument, to consist of a mass of minute molecules, some of them so small as to be called "the minutest visible points," and others, of the larger sort, "one thirty-thousandth part of an inch in diameter"! If the observation is continued long enough, or repeated at proper times, these molecules are seen to unite in twos and threes and fours, and up to eights. By-and-by self-moving creatures are said to be the result of these unions of molecules, and it is concluded that life without parentage has taken place. These first creatures die, and a new film is formed on the infusion, from which another set of animalcules are developed; these die, and another set come, and so on. This is clearly the evolution of higher forms from the ashes of lower going on in the microscopic world! Here I simply condense the long descriptions of the authors who write on this side of the subject.*

8. What, then, has old, stern Fact, and his equally severe friend Logic, to say in such a case? Their attention is inevitably turned to the *hay*. The substance infused, and whose infusion is boiled, is dried grass. No one, we should think, doubts that such a substance is full of the minute germs of both vegetable and animal life. "But boiling must destroy all such germs." Ah! there's the point. You say that no one doubts that the heat of boiling water, and cold at zero, destroy all animal and vegetable life. Then "no one" must be a rather sensible fellow, for his doubts are inevitable as the logical sequence of the very facts presented. Both vegetable and

* Professor Bennett's pamphlet has the best epitome of the subject I have seen.—(*The Atmospheric Germ Theory, &c.* A. & C. Black. Edinburgh. 1868.)

animal life, you say, appear after boiling for hours, and hence it is plain fact that they are *not destroyed!* Look steadily at that infusion. Before boiling it teems with infusorial being. It is boiled for six hours—for twenty-four if you choose—all animal and vegetable life, you say, must now be destroyed. You let it stand, however, for a time, and both animal and vegetable life appear. You insist that these living creatures are not produced from germs that have come in from without into this infusion. What, then, is the inevitable conclusion? Simply that the boiling has not done what you *say* it *must* have done.

9. There is no call to have recourse to germs in the atmosphere so long as the infusion in hand is either vegetable or animal, or so long as it has in it what we all know it to have had, a vegetable or animal existence. Pouchet, for example, plunges a flask into a decoction of barley which had been boiling for six hours, the flask was stoppered in the liquid and plunged in melted sealing-wax immediately on being taken out full. In six days yeast was observed in the flask. Was there ever a more logical conclusion from any fact than that six hours' boiling does not destroy the vegetating power of the yeast-germs in a decoction of barley? It is not merely because vegetation appears, but the very vegetation is seen which would have appeared had the barley been only steeped and not boiled. But the same error runs through all the arguments brought to bear in favour of this theory of generation. The decoctions boiled or chilled to zero do not bring forth only one kind of life. Each infusion has its own product. The doctrine that "life must spring from life" is that which this school of science seeks to refute; but how can it be refuted by such facts as distinctly establish this very doctrine, so far as they prove anything. In these experiments living substance—alive so far as the infusoria are concerned, though dead as to larger forms—is boiled or chilled, as we have said. Well, vegetable substance is living substance whose infusorial life boiling or chilling below zero fails to destroy; animal substance is living substance, whose infusorial life these processes fail to destroy. We say so in the light of all the facts which these men advance on the simple principle of common-sense, that when, in spite of boiling and chilling, specific life is still found in the substances, it is not destroyed. What sort of experiment is required so as to be of the slightest use on such a doctrine as this? Clearly, an experiment in which substance that has not lived shall be seen passing into life.

10. The importance of the controversy lies in its bearing on materialism. Does true life reside in matter that can be

seen, or does it reside only in substance which, from its very nature, cannot be seen? That which can be seen is capable of those affections which are now resolved into modes of motion. All these affections are produced from without the substances thus affected—the affections of life are from within, and not from without. They stand in the strong contrast of direct opposition to all such affections as colour, or any of its kindred. Are they, notwithstanding this, affections of a substance identical with that which never changes from within at all? The effort of the advocates who plead in favour of molecular generation is to prove that they are,—the difficulties that stand in their way are such as go to prove that they are affections of a substance which has no quality in common with matter strictly so called. If any substance in which life had never resided, or from which it could be demonstrated that all life had been utterly removed, could be seen to become alive of its own accord, we might then begin to consider whether life is only an affection of matter. But if what are only thought to be the ashes of that which has lived, and which is held to be now dead, should begin to move with true life, we see no reason to imagine that living substance has there been evolved from that which had no life. There is ample room among all such "ashes" for abundance of living substance so fine as even in the material particles connected with it to be invisible under the highest microscopical powers. It would be so far otherwise if that which had never lived should become truly alive. But it never does.

11. There is a very patent error by which the advocates of this evolution notion are strangely misled. They stop at the *ovum*, or *seed*, in going back to find the origin of life in the individual animal or plant; or, if they go further, they stop at the *cell*. Now it is clear, from the nature of the case, that we must go beyond the cell, and the aggregating molecules too, if we would go to the true origin. To show what I mean, let us take a seed which has just sprung into its first shoot. We presume that no one imagines that there is either seed or germinating cell yet in that shoot. The formation of such a seed or cell is yet distant in the growth and maturing of that plant. There will by-and-by be buds, and all things necessary to propagation, but these are not yet. At least, no one can imagine his seeing them with even the most powerful of microscopes. What, then, lies between that stage in the history of this plant and that further stage at which germ-cells are formed and seeds matured? Clearly, there must be stages at which films shall be formed whose molecules shall be aggregated till the germs of future individuals are complete. This must be

the case in the history of the largest as well as in that of the smallest creatures. The mammoth tree and the elephant alike must have sprung from something less visible than even a molecule in the parent tree and the parent animal. But that does not in the slightest degree affect the doctrine that life is derived only from life. When Professor Bennett says that "no one can doubt that an aggregation of molecules produces a vibrio, which, at first motionless, has contractility communicated to it, and thereby lives," he forgets that if the molecules are self-moving they are alive; he makes the strange blunder of imagining that life is not as essential to the self-aggregation of the molecules as to the contraction of the vibrio. The film in which the molecules are found, as he presents it, is living as truly as the vibrio that issues from the aggregation of molecules—it is so in the same sense of the term living, as that in which anything self-moving, however slowly, is living. The diffused substance from which this film comes is living at first in the same sense, and it passes through the heat of boiling alive, just as any living thing passes through any ordeal which is not destructive of its peculiar life. Whatever the substance is from which this film arises, it is clearly a substance in which there is a life indestructible by heat at the boiling point, and it is as clearly a substance that lived before in vegetable and animal forms, just as any larger substance that is now a seed lived in the individual plant whose seed it is. This is the plain teaching of the facts as presented, and instead of refuting it establishes the law that all life comes from life.

12. When, moreover, the generation of vibrios perishes, and another film rises to the surface, it is gratuitous to conclude that this has come from the ashes of these vibrios. If a mass of vegetable soil is turned over at a certain season of the year, one kind of plants will soon appear on it. When these have come and died another class will appear, and so on, just as the conditions change. This is exactly the same as that which occurs with the infusion on which the advocate of spontaneous generation is experimenting. And yet no one imagines that one class of plants, in such a case, is developed from the ashes of that which grew before it, without seed of its own kind being in the soil. This is true of animals as well as of plants. One class of insects come and go before another, and yet no one thinks of the one arising from the dust of the other. If we take one of Pouchet's experiments, quoted by Professor Bennett, we may see more clearly still how this reasoning applies. "If an infusion be placed in a deep glass vessel, which again stands in the centre of a shallow vessel, containing

the same infusion, and the whole covered with a large bell glass, it will be found in eight days that on the surface of the former are numerous ciliated animalcules, while on that of the latter only bacteria and vibrios exist. The experiment may be reversed, for if the shallow vessel be filled to the brim, and the deep vessel has only its bottom covered, then the ciliated microzoa will appear in the former, and the non-ciliated in the latter." What does this prove beyond the well-known truth that certain creatures will be developed in shallow water, and others only in deep water? The salmon seeks the bed of the shallow stream, on which to spawn, while other fishes seek deeper bottoms, because their ova are hatched best in different situations. What has this to do with the origin of life in matter whose organized character has been destroyed? It shows only the well-known truth that in varied conditions forms of life are variously brought forth—that the seed of a fir-tree will grow where that of a palm will lie dormant.

13. Professor Bennett says that "the conclusion which we must arrive at, therefore, is that the molecules seen on the surface of infusions out of which animalcules and fungi are produced, are not derived from the air." Here I can so far agree with him. But he says:—"Neither can they be supposed to pre-exist in the fluid, as then they would be readily seen, which they never are at the commencement. On this point nothing can be clearer than the microscopical evidence." * What are Dr. Bennett's own words in another communication of his on this very point? He says, "The ultimate molecule has never been reached, even with the highest magnifying powers. In the same manner that the astronomer with his telescope resolves nebulæ into clusters of stars, and sees other nebulæ beyond them, so the histologist, with his microscope, magnifies molecules into gemmules, and sees further molecules come into view."† Here, then, is a portion of the film which is taken from the surface of the infusion, and placed under the microscope. It is magnified into molecules. One of these is seen to unite with another, and two unite with a third, these with a fourth, and so on. But "the first change visible to the eye," he says, is a slight "*opalescence.*" Let us note this slight "*opalescence.*" ‡ Previous to this change nothing is seen in the infusion, but soon after this change has taken place, under high magnifying powers molecules may be seen. What, then, is the nature of the clear evidence that these

* *The Atmospheric Germ Theory*, p. 17.

† Paper "On the Molecular Theory of Generation," from the Proceedings of the Royal Society of Edinburgh, p. 2.

‡ *The Atmospheric Germ Theory*, p. 8.

molecules did not exist previously in the infusion? Simply *they were not seen in it!* The ultimate molecule has never been seen—some of these same molecules are barely visible,—and yet, because, previous to a change by which they appear, they did not appear, therefore they did not exist! The infusion has had twelve hours to work in, and yet, when it has gone on with its secret process, and reached that stage of upbuilding at which its products become visible, the existence of these very products previous to their being visible is denied? This is surely lame logic.

14. Not only is there absolutely no evidence of the nonexistence of the molecules—there is clear and positive evidence that the process in which they appear is one of gradual enlargement. They come into view one after another, and increase in size when they have appeared. It is not imagined that they do so by coming nearer to the eye, or better into focus, and it can only be by enlargement. All analogy leads us to interpret the facts as those which indicate that the germs of these vibrios are small enough to elude the highest magnifying powers yet employed. The effect of a spermatozoid on the molecules of the yolk of an egg is identical with the effect produced on the molecules in the film on the surface of an infusion. There is not the very slightest evidence that, though unseen, there are not spermatozoids affecting the molecules, which Dr. Bennett and his friends see formed into vibrios.

15. Dr. Allen Thomson says that "most physiologists are inclined to reject as fanciful and inaccurate the alleged observations of the actual conversion of particles of organized or organic matter into living infusoria."* This is a part of the field in which it would be presumptive for me to judge, but it is not necessary to do so. Taking the "observations," as we have done, from one of the very stanchest advocates of the notion of life springing from that in which there is no life, it is not difficult to see that, if the observations are ever so correct, the reasoning from these observations is utterly wrong.

16. How far then does this effort to refute the doctrine that "all life comes from life," tend to enlighten us as to the great problem of life itself? It carries us in, we shall say, from the self-moving force observed in the large animal to that force seen in the self-moving molecule; does it then modify in any degree our idea of the self-moving faculty itself? Has the microscope, by enabling us to see molecules forming themselves into vibrios, brought us any nearer to an answer to

* *Cyclopædia of Anatomy and Physiology*, vol. v. p. 10. 1859.

the question as to what it is by the exercise of which molecules or men perform their movements? What we call the inorganic matter of the world moves only as those forces that affect it are brought to bear upon its particles, or molecules if you will. The living being, be it plant or animal, is capable of moving itself into the current of those forces by which it is affected. A hailstone is melted when the sun shines upon it; but it does not move itself into the sun's rays, as even a petal does by opening itself up when the sun is shining. It is this self-moving that tells us of life. Heat can be so introduced into the dying body as apparently (if not really) to pass into what may be called life; but it is not such life that is of deepest interest. It is that life by which heat may be produced at will by the living agent. We want to get at the true explanation of the difference between these two movements—that which is an effect and that which is a cause. It is no use telling us that there is no such thing as a cause in the sense in which we use the term. You may just as well tell us there is nothing. Even the molecule that moves up to another molecule and joins it compels us to think of something, which is not an effect in the sense in which the rolling of a stone in the river is one. The microscope takes us down to a region where men fancy that they see the passing of the organic into the inorganic, but they demonstrate rather by what they tell us that no such passing is to be seen. Life belongs to a creation of its own—a creation which is using the inorganic, as the inorganic is constantly taking back, as it were, that which the living have used. What is that grand distinction which separates these two creations?

17. We must lay aside the microscope and have recourse to thinking instead of seeing, in order to our having the reply. We must get rid of the fancy of "contractility," which can be seen, and turn to that which contracts and manages the contraction so as even to convey thought from man to man. The miser may as well tell the robber that there is no money in his house because it is not yet to be seen, as philosophers (so-called) may tell us that there is nothing but molecules and protoplasm in plants and animals because they can see nothing else with a magnifying power of 2,000 diameters. There is a spirit of the beast that goeth downward, and a spirit of man that goeth upward, though neither can be brought under the lens. That spirit is living in the beast, and so is the superior spirit in the man. In so far as there is true self-movement in the plant, there is a spirit there too. There is no satisfactory solution of the problem of life, if we exclude this spirit or self-moving entity.

18. It may no doubt be said that we are uttering merely the result of a prejudice. But from whence does that so-called prejudice arise? Our inner consciousness is as real as our eyesight. In that consciousness there is a distinction made, whether we will or not, between our volitions and our material movements. He who, for example, wills as usual to lift his arm, or to move his tongue, and finds he cannot, has a sad proof of the distinction. The will is left, but the muscular capacity is gone. It would be very difficult indeed to disabuse him of the thought that the willing substance is one and the contracting, or rather non-contracting, muscles another. Man is not all sense, and hence he is incapable of confining himself to what are called "phenomena." It is only trifling to try so to confine him by calling the facts of his consciousness by bad names. It is not in our power to confound the movements which originate in our wills, or rather in ourselves as creatures capable of volition, with those that affect us independently or in spite of ourselves. So, neither is it possible for us to explain similar movements in other creatures as caused in these from without, when we see them in those movements clearly self-moving. We repel the charge of prejudice and appeal to the facts of consciousness. We conclude, therefore, that self-motion, or life, resides in the immaterial, and is not to be explained any more than originated by mere molecular evolution.

19. It is here that nature conducts us to the world of true spirit, and lifts us above the material. True science will not allow us to stay among the molecules—it forces us beyond, unless we refuse altogether to be conducted by the truth. This appears very clearly when we compare the most lifelike movements of inorganic matter with that which is really and properly life. Take magnetism for an example. The motions of the needle of a magnetic telegraph look to the ordinary spectator wonderfully lifelike. And yet they are utterly dependent on the motions of the living hand which regulates them. Take the still more lifelike movements of elasticity seen in the pointers of the watch. These look automatic indeed, and yet they are precisely what the living agency causes them to be by which the machinery has been fashioned and wound. Take any of the wonderful combinations of chemistry, and the "behaviour" of certain substances is wonderfully lifelike, but all absolutely *caused* and *modified* as the manipulator determines. The instant you come to real life, if it should be seen even in a molecule, there is self-determination. That self-determination is limited, it is true, but it is real within its limits. No power of mine can order it as that power easily orders in its minutest motions all other force. It is this which gives the problem of

life its deep and intense interest, and links it on to a world of being, no part of which is subject to either the microscope or the telescope, or to any other instrument that deals with purely material things, small or great. What an interest to the "histologist" is there in a vibrio that only "wriggles"! And all just because it is not "wriggled," but "wriggles"! What an interest in the fungus that grows and dies, and leaves its spores that grow and die and leave spores again! Why such an interest even in the plant? Because it is a thing of life that does its own upbuilding, and cannot have that upbuilding done for it by any creature skill. It is seen even in molecules that do their own work, and cannot be helped in doing it by any agency of human kind. It is not wonderful that men are more interested in this life than in any other thing in nature. From the self-moving will within a man himself, down through all wills, to that of the molecule (that seems to have one also), there is perceived to be something of kinship of an irresistibly interesting character. We call it LIFE. It is not God, but it is something even in the molecule that moves of itself (if molecules do), that tells us of Him as no inanimate thing tells us. It is something which no skill of man can imitate, except in the most clumsy of counterfeits. The automaton of human workmanship does mathematically what its mover causes it to do. It does not move an atom of itself. The most humble of living things does a certain amount of work of its own. You rightly trace the motions of a man to their ultimate source in his own will; so do you rightly trace the motions of a ciliated animalcule, or even the wrigglings of a vibrio.

20. It is the perception of this which makes us impatient of that worship of "phenomena" by which men are so fond of chaining themselves down to the miserable materialism which believes in nothing but what it sees. *We cannot see true life.* We can see the phenomena of life, but that is not the life of which these are the phenomena. We can see magnetism, for magnetism is itself nothing but a certain motion in that which is affected magnetically. A magnetic current is, I believe, just like a gravitating current, such as that of water, and both may be seen. Even in the case of the motion in water caused by the cilia of an animalcule, you can see the motion of the water and the motion of the cilia, but you see the motion of the water caused by that of the cilia, and you perceive the motion of the cilia caused by something which you cannot see. Reason *will* go beyond the seen in such phenomena as this. It is no use talking of "antecedents and consequents" when we have come to a consequent which has either no ante-

cedent or which must have an unseen one. If you will talk of "antecedents" at all here you must grant this unseen one and stop there. The will is an antecedent that in true philosophy has none to convert it in turn into a consequent. Here, then, we must get beyond the material; and when we are fairly into the immaterial as a real world of being, we soon see Him who not only lives, but who also gives life—who not only moves himself and moves others, but who gives that wonderful capability of self-movement which alone is truly life. You may call that which has the capacity of self-movement "mind," or you may hesitate to apply the word "mind" in such a way as that it should be applied to even the lowest of living things; but name it as you may, it is a substance totally different from merely movable substances, such as has no capacity of self-movement whatever; and when we name this living being—what perhaps Professor Huxley, if he once saw it, would call the protoplasm of spirit,—we have the field in which to go forward investigating the true natural history of life from its lowest to its highest manifestations as these are made known in Him who is the source of all.

21. Let the student of life be well aware that should he surrender the truth at that point at which self-movement begins, and allow the bald chemistry of unbelief to cheat him out of his faith in the unseen but real substance of spirit, he will not soon repair his loss. Even in studies purely natural he will proceed at a disadvantage never sufficiently to be deplored; and when we think of the inseparable connection that exists between the natural and moral, as well as between the natural and highest spiritual realities, he will find himself groping in darkness where light is more precious than gold. On the other hand, let him hold fast to the truth which carries him up from that which is seen, by the most gentle steps which the soul can tread, and he will find natural studies explicable in the highest sense; he will see the loftiest reasons for moral goodness; and, what is best of all, he will find the Father of mercies, and recognize the manifestation of that Father in Immanuel.

The CHAIRMAN.—I think I may take it upon myself to express to Professor Kirk the satisfaction which we all feel at seeing him here among us (hear, hear); and also our gratitude to him for those valuable papers of his which have already appeared in our *Journal of Transactions*. We possess now another contribution from him of equal value with those which have gone before. I must ask you to return thanks to Professor Kirk for what he has already done for us, and especially for the valuable, thoughtful, and useful paper which he has read to us this evening. (Cheers.)

Mr. BROOKE, V.P.—I have been very much gratified by this paper of Professor Kirk's, and although I have not heard the whole of it here to-night, I may say that I carefully read it all before I entered this room. I must fully endorse the conclusions at which Mr. Kirk has so ably arrived; but it occurred to me while the latter part of the paper was being read, to offer just one illustration which may not be unacceptable, of the fact that the non-visibility of matter in a fluid is no proof whatever of its non-existence. Many years ago the late Professor Faraday gave me a bottle containing a clear, transparent fluid of a reddish-purple tint. Now that fluid was known to contain gold—it was water, in fact, in which gold was suspended in an extremely minutely subdivided form, and Professor Faraday gave me the bottle in order that I might subject it to a careful microscopic examination, to see if the highest power of the microscope could detect material particles of gold in it. The little gold particles were so evenly distributed that they remained suspended in the fluid and did not subside, but they simply communicated to the water that purple tint which gold possesses when viewed in transmitted light. If you take a piece of gold leaf between two plates of glass and look through it, you will find that it freely transmits light of a purple colour. I submitted the fluid to the very highest powers which the microscope presents. It was magnified up to 6,000 diameters, which is about as high a power as can be commanded, and still there was not the slightest trace of any visible particles. You could not trace the particles, but yet you knew they were there. Now that very fluid, after my examination had satisfied me that the gold was not discoverable by any visual means, was set by in the bottle for a year or two. At the end of that time I found that a little sediment had settled at the bottom of the water; and that sediment presented all the appearance of gold dust in a minutely divided state. But the water was no longer capable by shaking of being restored to its former colour—the bottle merely contained a mixture of visible particles of gold with water. Because at first no microscopic investigation could detect the particles, it might have been said that they did not exist in the water; but they manifestly did exist there, although the microscope was wholly unable to detect their material presence. This is a familiar and palpable example of the fact, that molecules or particles of matter not being visible is not the slightest evidence of their non-existence. Now it is very important that in so valuable a paper as the one now before us there should not be the least departure from logical deduction; but there are one or two points in the paper on which I should like to make a few observations. In the second paragraph Professor Kirk speaks of life in an object as "self-movement." Now I should rather take exception to that definition, of the fact of movement being taken as fundamental evidence of individual life. For example, the cells of ciliated epithelium which may be stripped off the back part of the throat, will be found under the microscope to consist of little ciliated particles, which will move about by ciliary action in the fluid in which they are suspended; but we can no more consider them to be individual organisms, or to possess individual life, than we can suppose the effete particles of epidermis

which are constantly rubbed off the surface of the skin to possess individual vitality. They are particles which have served their purpose and are thrown off, but are no more living individuals because they move about, than would be bits of hair or any other perfectly effete portion of the animal frame——

Mr. REDDIE.—Then their movement is mechanical?

Mr. BROOKE.—That I am not prepared to say, but it does exist. The movement does exist, and it is mechanical certainly; but whence the motion is derived, and what are the causes of ciliary motion, I do not take upon myself to define. I can only point to the fact that we cannot take self-movement of itself as an evidence of life or individual vitality.

Mr. REDDIE.—But you do not take Professor Kirk's own qualification of the definition. He says, not that all movement is life, but only that where there is life there must be self-movement.

Professor KIRK.—I do not say that all movement is life, but that all *self*-movement is.

Mr. BROOKE.—But I say that we must not go to movement as an evidence of the existence of life. In the 18th paragraph of the paper Professor Kirk says:—

"Our inner consciousness is as real as our eyesight. In that consciousness there is a distinction made, whether we will or not, between our volitions and our material movements. He who, for example, wills as usual to lift his arm or to move his tongue, and finds he cannot, has a sad proof of the distinction. The will is left, but the muscular capacity is gone."

Now I must take exception to that as a matter of fact. In the case of paralysis, where the power of moving the tongue, for example, is entirely lost, it does not follow that the muscular capacity is gone—it is only that the medium of communication between the mind and the muscle is damaged, and volition is no longer transmitted to the muscle. The directing influence of the brain is no longer transmitted; but it does not therefore follow that the muscular capacity is gone. That point in the 18th paragraph should be borne in mind as one which is not strictly accurate. Then in the 20th paragraph Professor Kirk says:—

"You may call that which has the capacity of self-movement 'mind.'"

Now I do not think you can apply that term to the capacity of self-movement. I would rather define mind to be the power of combining ideas. I think the best definition of mind that can be given is simply that of the power of comparing and associating ideas; and we cannot apply the term "mind" exactly in the way that Professor Kirk here suggests. I take the liberty of making these one or two observations as not at all interfering with the general scope and argument of the paper, but as pointing out one or two matters of inaccuracy which it would be desirable to modify. So far, however, as the general conclusions of the paper go, I am most happy to give my full and complete adherence to them. (Cheers.)

Mr. REDDIE.—I think it may not be uninteresting, as following Mr. Brooke's valuable remarks, to point out, with reference to the colouring of water by invisible particles of gold, that it is by means of particles of gold

and other metals that the richest tints in coloured glass are produced. If gold could always be used, it would produce a very rich carmine or crimson tint; but it is too expensive, and metals are used producing tints approximating to it, like the older and richest tones of stained glass, as found in our old cathedrals, and which tones our artists now imitate with very great success. The reason why I asked if the ciliary motion, referred to by Mr. Brooke, is mechanical, was because, if the matter is positively dead, I do not see how any movement can arise unless in the same way that a piece of paper in the air is moved about, mechanically, in consequence of its shape. With reference to Professor Kirk's paper, I agree with what has already been said as to its great value. I think it is as carefully written, although a shorter paper, than any of the others with which Professor Kirk has hitherto favoured us. There is, however, one part of it to which possibly our opponents will take exception, and therefore, perhaps, Professor Kirk will not be sorry to have it noticed, though it looks almost hypercritical to point it out. In the 11th paragraph Mr. Kirk says :—

"When Professor Bennett says that 'no one can doubt that an aggregation of molecules produces a vibrio, which, at first motionless, has contractility communicated to it, and thereby lives,' he forgets that if the molecules are self-moving they are alive; he makes the strange blunder of imagining that life is not as essential to the self-aggregation of the molecules as to the contraction of the vibrio."

I fancy that that "self-aggregation" Professor Bennett would say arises merely from the attraction of the particles to one another. So that the result would be that in time there would be an aggregation of particles which would be inseparable except by some chemical means, producing isolation. There is one other part of the paper where a similar remark occurs, and where our opponents would argue that these things were merely drawn together, and then began to live. They do not explain whether the cells are of different characters or not—perhaps they may be male and female, and so produce generation. That is a very remarkable fact which Professor Kirk calls attention to—that boiling does not destroy the life of these animalcules; but we have plenty of illustrations of an analogous kind to enable us to understand this. A few years ago people would have said it was almost impossible to stand the heat of a Turkish bath, where you may have boiling water alongside of you. Chantrey also went into his oven where he baked his models at a heat of some 300 degrees; and there was a famous "fire-eater" at one time who used to exhibit, and have ducks roasted by his side in an oven, and afterwards ate them, and he suffered nothing from this heat. It is not only true that boiling will not destroy life in these animalcules, but we have also learnt from Dr. Carpenter that you cannot even squeeze the life out of them! Dr. Carpenter, as is well known, has recently been exploring the ocean-bed of the Atlantic. Formerly it was given out among scientific men, that animal life could not exist at a depth of 300 yards, or less than a quarter of a mile; but now we find that they live at a depth of three or four miles down, where the pressure is so great that the tubes of the

thermometers used to obtain the temperature were actually compressed, so that there was an artificial heat assigned to the temperature from that cause. Yet animal life was going on there to a very great extent. Of the many specimens found alive and healthy, some were found to be occupying tracts with an arctic climate, and some in a much warmer temperature ; and these variations were found not far apart from each other, and on the same ocean-bottom. Another important discovery is said to have been made at the same time : they discovered what was supposed to be an extinct species of animal fauna at the bottom of the sea, and it was found that those animals could live without vegetables. It used to be supposed that "protoplasm" required to be passed through a vegetable form before animal life could live upon it ; but Dr. Carpenter told us, a few days ago, at the Royal Institution, that a great many of these creatures were found living where there was no vegetable pabulum for them at all. And no sooner is that supposed to be discovered (for it does not follow that vegetable matter does not exist there) than we also find it discovered, that there is diffused protoplasm in the sea itself ; and that the animals get their vegetable food supplied for them in the water of the ocean ! I have not read anything in print about this, and my statement is therefore necessarily a little vague ; but what I tell you is substantially correct,—that there is a diffused protoplasm—a sort of mixture of the constituents of protoplasm—in the ocean at these depths, which the animals can appropriate and live upon without the intervention of any vegetable media. Now that is very important with reference to many creative theories. (Hear, hear.) With regard to this boiling of animals, it occurs to me that this is not the first time that experiments have been made of this kind, and in pursuance of something like former Darwinian views. A very famous member of the greatest scientific society in England, or indeed in the world—I mean Sir Joseph Banks, of the Royal Society—had many years ago a notion somewhat similar to Mr. Darwin's, that certain little animals would grow into bigger ones, and so develop into a different kind altogether. No doubt some of you will remember the lines :—

> "Big fleas have little fleas upon their backs to bite 'em,
> And little fleas have lesser fleas, and so *ad infinitum :*
> While great fleas themselves in turn have greater fleas to go on,
> And they again have greater still, and greater still, and so on."

(Laughter.) Now Sir Joseph Banks thought there was a strong resemblance between a flea and a lobster (renewed laughter), and so he boiled his fleas, and he was in a terrible state of mind (I must not say what expletives he used), because they would not boil red ! (Laughter.) From his experiment, we find that the boiling process is not a new one ; but I do not suppose the flea survived the process, though I understand that it takes a great deal of heat to destroy that animal. (Laughter.) There is one other thing I should like to say. I think, so far as Professor Kirk has gone, he has completely demonstrated his case, that visible life certainly proceeds from something invisible, and that you have as much proof of the invisible will which precedes the visible motion as you

have of life itself. (Hear, hear.) You have exactly the same sort of thing in the inorganic world. If you take any solid, it begins in something immaterial, and which you cannot analyze. Take the form of crystallization in water—a yielding fluid, to which that hardness is imparted which gives us an idea of the solidity of material things. That hardness is caused by cold —a so-called "negation." You have something (caloric) abstracted from the soft water, and you get a hard substance produced. You have in the solid material of this table, and in all the oaks of the forest, a solid matter built up merely of air acting upon a little seed. For what does it feed upon? Literally upon gases! This solid material is built up of carbonic acid gas and of various other gases: and the same may be said of all things, if you trace them up to their beginnings. Now it is a very important argument to show that life must needs commence in something invisible. I quite understand what Professor Kirk means by "mind," though we had some difficulty in a previous paper of his in understanding the application of the term. Professor Kirk does not intend by "mind" to imply thought, but something that can will. There must be a kind of conscious action. No doubt we are much more used to applying the word "mind" in the way in which Mr. Brooke has used it; but I can quite understand the other application of it. It is an invisible, and not a material thing, that he speaks of; but I think it a real, and, if we could elaborate the argument, I would go further, and say a *more real* thing than matter. I think the mental and invisible are at the bottom of all that is visible. You may trace everything back to something invisible, and, without putting forward any Berkleyan views, which may be questioned, I think you will find that the substratum of everything visible is merely a law, and that every such thing could be resolved into immaterial substances.

Mr. Brooke.—I should like to say a word with regard to the fact which I mentioned before, as to the thermometer used in the deep-sea soundings registering an artificial temperature. The ordinary thermometers gave no reliable results in the deep-sea soundings at all, because the bulbs were so compressed that they drove the mercury up into the tube without any reference to the temperature. The only means of getting at the temperature was by using jacketed thermometers, in which the space between the outer bulb and the true bulb contained a quantity of spirit not quite filling it, to allow for the pressure it would be subjected to. When this thermometer was submerged, the only effect was to reduce the size of the outer bulb a little and displace the spirit, but without communicating any pressure to the interior bulb, which, therefore, then indicated the proper temperature. (Cheers.) With regard to motion not being necessarily an indication of individual life or existence, I may say that throughout the whole range of the animal kingdom the formation of an individual is due to the conjoined action or influence of two elements—what may be called the germ cell, and what may be called the sperm cell. These are developed in many cases in two different sexes, but in many cases they are found in the same individual. The concurrence of the two, however, is necessary for the reproduction of the kind, whatever it may be.

Now these sperm cells are generally supplied with one long appendage, by which they freely move about. Under the microscope they look very much like tadpoles with long tails, and they swim about as freely as tadpoles in water. But no one would attribute to them individual vitality as individual organisms. They are only the machinery subservient to the development of an organism, but they are not organisms themselves ; and therefore the fact of their motion does not imply automatic motion, nor is it necessarily an indication of individual life. (Cheers.)

Admiral FISHBOURNE.—Self-directed movement would perhaps meet the case, instead of self-movement : any self-movement which is the result of mind or will.

The CHAIRMAN.—I have to add but a very few words to what has been already said upon this paper. I repeat that we owe much to Professor Kirk for this valuable and important contribution to our proceedings. (Hear, hear.) Its importance consists in this, that he has laid his finger on one of the points, if not the most important one, in regard to which our opponents are obliged to confess that they do not know. When we turn to the material world, we find by the microscope and by the telescope, and by the experiments we make, a number of appearances which our opponents declare to be, and some of which no doubt are, real facts ; but when we come to the mysterious, unintelligible principle of life, they, equally with us, are obliged to confess that they do not know whence it arises. They tell us of molecules, and protozoa, and organisms, and primal organisms, and so on ; and they have now added protoplasm as the first origin of all things ; but they are unable to tell us anything of the origin of life, and must confess to the existence of a world beyond their ken and ours. (Cheers.) I have now only to call upon Professor Kirk to reply upon the discussion.

Professor KIRK.—I scarcely think it is necessary for me to make any observations in reply, because your criticisms have been so very gentle that there is almost nothing upon which I can found any remark of a substantial character. As to what is meant by life, I do not think it is necessary for us to gather our thoughts round a word, or the use of a word. What I understand when I use the term life in the sense in which we employ it in such a discussion as this, is self-movement, not confining it to the self-movement of an individual organism in the usual sense, but to the self-movement of whatever moves of itself. I am not able to say whether molecules move of themselves or not. I speak according to the description of Professor Bennett, who speaks of them as moving and coming together of themselves ; and I take what he says in the way of using it as an argument against his own ideas. (Hear, hear.) But so far as I am able, with careful and close thinking, to form a conception which I can satisfactorily express by the word "life" in the general, self-movement seems to me to be necessary to that——

Rev. C. A. ROW.—May I ask whether you mean self-movement or the power of self-movement ?

Professor KIRK.—I mean the power of self-movement.

Mr. ROW.—I thought so.

Professor KIRK.—The power of self-movement when you think of it potentially, and self-movement when you think of it actually. I merely say this to show that it is in a great measure about the meaning of a word on which we shall be occupied if we enter into a discussion on that point. The same with regard to the word "mind." I hesitate to use, or to ask others to use, the word "mind" as expressive of that entity in which the faculty of self-movement exists, just because we are so accustomed to use the word "mind" in another sense. I should hesitate to use the word "spirit" in that way, because we are accustomed to it in a more limited sense. Yet we know that in the Scriptures the word "spirit" is used to describe that which is generally described by us by the mere negative term "immaterial," which says nothing, but merely expresses a negative condition.

Mr. Row.—Would not the word "soul" suit you?

Professor Kirk.—That is in the same position, as being used for the immortal spirit of man which God implanted. But in my paper I felt the necessity of leaving every one to use his own word, which should mean something quite different from matter, only which should be as real as matter, at least in having the faculty of self-movement. There are some of the points to which Mr. Brooke alluded on which perhaps I might have made one or two remarks, but still they seemed to me to have grouped themselves under this head, that they convinced me that if I had had the paper to write over again, and plenty of time to write it and to re-write it, I should be able perhaps to bring it into a form in which it would be less accessible to the hostile criticism of those who oppose my view. Mr. Reddie has said that for the first time I have to-night been able to give you a short paper. I am afraid I made a virtue of necessity in writing a short paper, and, indeed, too hurried a paper; but I am very glad that, so far as my efforts have gone, you are agreed as to the validity of the great conclusion. (Cheers.) It is a conclusion which leads us to have before our minds the real world of spirit, as truly as we have before our minds the real—I may even say with Mr. Reddie, the less real, world of matter. (Cheers.)

The meeting was then adjourned.